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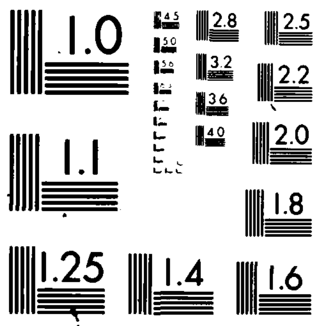

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Second Meeting of the High Altitude Pollution Program Scientific Advisory Committee March 28-30, 1979

U.S. Department of Transportation
Federal Aviation Administration

Office of Environment and Energy
Washington, D.C. 20591

Executive Summary

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FAA-EE-80-08	AD-A098 763	

4. Title and Subtitle	
Executive Summary, Second Meeting of the High Altitude Pollution Program Scientific Advisory Committee	5. Report Date: September 1980
	6. Performing Organization Code: AEE-300
7. Author(s)	8. Performing Organization Report No.: FAA-EE-80-08
9. Performing Organization Name and Address: U.S. Department of Transportation, Federal Aviation Administration, Office of Environment and Energy, Washington, D.C. 20591	10. Work Unit No. (TRAIS)
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address: U.S. Department of Transportation, Federal Aviation Administration, Office of Environment and Energy, Washington, D.C. 20591	13. Type of Report and Period Covered: Executive Summary, March 28-30, 1979
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The High Altitude Pollution Program (HAPP) Scientific Advisory Committee held its second meeting during March 28-30, 1979 at the Federal Aviation Administration (FAA) Headquarters in Washington, D.C. The purpose of this meeting was to discuss the field measurement experiments. Atmospheric measurements form a critical element in the validation process of the atmospheric models used to assess the impact of aviation on the stratosphere. The Federal Aviation Administration carries out these measurements in cooperation with the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration. Principal investigators working on different aspects of the field measurements program presented technical progress reports to the Committee. Such issues as the measurement strategy, data utilization, and coordination with other Federal programs were discussed.

This Executive Summary includes the Committee Chairman's presentation of the findings of the meeting to the Acting Director of Environment and Energy as Part I and the Committee's recommendations for field measurements (as noted by the Rapporteur) as Part II. Three appendixes at the end contain the meeting agenda, list of attendees and participants, and the Committee Charter and membership respectively.

17. Key Words	18. Distribution Statement
Ozone, Atmospheric Measurements, Aircraft Effects on the Stratosphere, High Altitude Pollution Program	Available to the Public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

12) 35

14) FAA/EE-79-08

11) Apr 79

6) SECOND MEETING

OF THE

HIGH ALTITUDE POLLUTION PROGRAM

SCIENTIFIC ADVISORY COMMITTEE

March 28 - 30, 1979,

Washington, D.C.

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BACKGROUND

The High Altitude Pollution Program (HAPP) Scientific Advisory Committee held its second meeting during March 28-30, 1979, at the Federal Aviation Administration (FAA) Headquarters in Washington, D.C. The purpose of this meeting was to discuss the field measurement experiments. Atmospheric measurements form a critical element in the validation process of the atmospheric models used to assess the impact of aviation on the stratosphere. The Federal Aviation Administration carries out these measurements in cooperation with the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration. Principal investigators working on different aspects of the field measurements program presented technical progress reports to the Committee. Such issues as the measurement strategy, data utilization, and coordination with other Federal programs were discussed.

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The Chairman's presentation is taken directly from the transcript of the Committee's proceedings, except for editorial changes made for ease of reading. The Committee recommendations are a summary of the discussions. A complete copy of the transcript may be reviewed at the office of the High Altitude Pollution Program (AEE-300), Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C., telephone (202) 755-8933.

PART I

CHAIRMAN'S PRESENTATION

OF THE FINDINGS

OF THE MEETING

TO THE

ACTING DIRECTOR

OF

ENVIRONMENT AND ENERGY

CHAIRMAN ROWLAND: What I plan to do now is to give a short summary of the purpose of the Committee and of the specific deliberations in the last three days. In making this summary, I want to emphasize the position of the Committee on the whole over a period of time and not so much specifically what has gone on in the last several days.

The atmosphere -- this is a report directed to Mr. Densmore but to which everybody else can listen -- the atmosphere is very complex and in trying to understand it, the two main ingredients are the chemistry and the meteorology. Putting it very simply, if a chemical compound is found at a particular location at one time and it is not there a day later, it can have either chemically reacted to go away or it can have been transported away by winds. The complexities of the atmosphere involve the intermixing of chemical reactions, and meteorological processes which are often designated as transport. The atmosphere is so complex that the treatments of it require that you simplify it and make models. If you are charged with trying to evaluate whether the effect of aircraft flying through the atmosphere will have an effect on the atmosphere, then you have to ask what will happen to the materials that are emitted from the aircraft. The particular emphasis has been on the nitrogen oxides which are an inevitable accompaniment to the passage of air through an engine at high temperatures. Some nitrogen and oxygen are converted to nitrogen oxides and they are emitted from any hot engine passing through air.

So pollutants are forming in the process of flying aircraft through the atmosphere. The emphasis in the early 1970's was on the emission of the nitrogen oxides from the aircraft into the stratosphere where the chemical reactions involving the nitrogen oxides are intimately involved with the amount of ozone that is present in the stratosphere.

The simplest model of the atmosphere that we use is called a 1D model. It has only vertical variations and is a sort of an average for the world. The simplest 1D models in 1975 showed that the emission of nitrogen oxides from supersonic aircraft flying at 20 kilometers would have caused an appreciable loss in ozone. It was understood at that time that there were many uncertainties involved. Some of these uncertainties were in the chemistry and some of these were in the modeling of the atmosphere itself.

Understanding the particular effects of aircraft pollutants, which are injected at particular altitudes and along certain flight corridors, certainly requires more complex models of the atmosphere than a 1D model, which averages the entire world. This leads us toward two-dimensional and three-dimensional models, which are more complex to handle and require development. The understanding of stratospheric chemistry was incomplete in the 1975 time frame. There have been a number of investigations since then, which have given more detailed understanding of the chemistry.

In about the 1977 time period, the further understanding of chemistry caused a reevaluation of the simple 1D model results. It showed that there was no longer a prediction of a large net loss of ozone. The simple 1D model, however, did show that there would be a small loss of ozone at higher altitudes counter-balanced, and in fact a little bit over-balanced by production of ozone at lower altitudes. What had been a very simple statement that there would be a net loss of ozone became the more complex result that there would be a redistribution of ozone such that there was less at higher altitudes and more at lower altitudes.

This makes the evaluation of whether there is an environmental problem associated with the release of nitrogen oxides very much more complex than it was several years ago. The present emphasis of the High Altitude Pollution Program has to be on two aspects. One is on the modeling of the atmosphere in order to understand on a two- or three-dimensional basis what the chemical effects would be of the injection of nitrogen oxides. That is one of the strong focuses of present attempts to understand the stratosphere.

In order to have believable models, one needs to have experimental tests of the models and much of the discussion of these three days has been devoted to field measurements. There are in fact specific tests of the models to be sure that you are including all of the necessary chemistry and, as much as possible, taking adequate account of the transport, that is, the meteorology. We had a long discussion about the appropriateness of particular field experiments. We are recommending continuation of the development of experiments which can then be sent into the stratosphere to measure nitrogen oxides, compounds which are there naturally and which are also introduced by the aircraft. We want to be sure that we understand the chemistry of nitrogen oxides in the stratosphere. For this, we need simultaneous measurements of nitrogen oxide and nitrogen dioxide.

The ultimate goal of this work is to assure ourselves that the chemistry which goes into the models is adequately understood so that the observations in the atmosphere agree with the model predictions. The main emphasis of this meeting has been on validating the models through field experiments. It is particularly appropriate for FAA and for the High Altitude Pollution Program to do these field measurements to validate the models with the nitrogen oxides because the nitrogen oxides coming from the aircraft are the specific pollutant which is a major concern.

One of the possible findings with the three-dimensional models when they are developed could be, for example, that the loss of ozone at high altitudes might be taking place over the tropics and the creation at low altitudes might be taking place over Canada. In the one-dimensional model, these tend to average in the total column. But in the three-dimensional model, it might not average out. It is our belief that the FAA needs to know, on a three-dimensional basis, whether ozone is going to be rising and falling, total column, in

Canada, Panama, and the United States and also the distribution in each location. We are aiming toward a three-dimensional model which has been sufficently tested with reduced uncertainty in the chemistry so as to say that this is a reasonable description of the behavior of the real atmosphere.

In the longer term, there is the additional problem of understanding the motion of the pollutants which are emitted into the atmosphere by the aircraft. A second field measurement has been discussed. Since it is not ready for implementation, we recommend continuation of feasibility studies. The second experiment is a tracer experiment. A molecule, which could be subsequently identified and which would behave somewhat like the nitrogen oxides, might be injected into the atmosphere in the corridors flown by aircraft in the lower stratosphere. It would simply be followed around as it is transported by the atmosphere to test our understanding of motions of pollutants in the real atmosphere.

That is further down the line but it is an experiment whose feasibility we are urging the FAA to continue to study. Such an experiment would probably find international interest in carrying it out. There are many people who might be interested in doing an experiment which would test the motions of gases. The specific interest of the FAA, in getting involved in this, would be to insure that the test injections would be made at an altitude and latitude that are of interest to aviation. There are many ways that you could test the motions in the atmosphere but, for FAA's purposes, it would be a good idea if the test simulated the injection of pollutants from aircraft rather than from rockets or something else. That is the important reason for FAA to be in at the beginning of the planning of such an experiment.

There are other possible pollutants, water vapor, particles, and so on that can come from aircraft. These have received less attention so far because the prime interest has been on modeling of the stratosphere and of the particular pollutant, nitrogen oxides. We are paying attention to these other possibilities as well.

We are prepared to answer any questions that you might want to ask at this point.

MR. DENSMORE: Okay, let me say a couple of things in preamble. Then I would like to ask a couple of questions I think at this point.

First of all, I was put in the position of being responsible for the office only two weeks ago and I would much have preferred to have spent more time with you and I feel a little bit like a water skier who is trying to catch up with the boat and I think maybe I am on the wrong vehicle to try and do that. But to me, it would have been important to spend more time on this for the following reason: your collective judgment on what the program ought to be and is, of course, the principal objective here, but somehow or other, I have to translate this into support for it, at least with the FAA.

So the questions I want to ask really relate to that rather than the technical aspects of what you are discussing here. I think I know the answers to the questions I am going to ask, but I hope you have better answers than I have been able to think up. Really, these come about because of the people in the FAA who review these kinds of programs.

Okay, the first question is, of course, supersonic airplanes have been flying for ten years at least, and have measurements to date detected any differences as a consequence of supersonic airplanes having been flown?

CHAIRMAN ROWLAND: The answer is "no." The supersonic aircraft certainly put in pollutants but the number of aircraft that have been flying and the frequency of flying is negligibly small. The advice as far as the scientific community is concerned is directed toward looking down 5, 10, 15 years away. All of the calculations and modeling have been done on the assumption that an economically successful supersonic aircraft design had been achieved and that the various countries were building fleets of several hundred of these aircraft. The possibility of detecting anything when you have only 9 or 15 aircraft flying is very much more difficult than if you had 500 flying. What we want to do is to anticipate what will happen if 500 are flying and if necessary, hopefully anticipate any problems, so that you can attempt to forestall them.

It is certainly true that if you have 500 supersonic aircraft flying then you will be putting nitrogen oxides into the atmosphere in very much larger quantity than you are with the present Concorde fleets.

ASSISTANT TO DENSMORE: DOD aircraft are also flying.

CHAIRMAN ROWLAND: Well, the problem with military aircraft in a very crude approximation is that there are two kinds of military aircraft. There are fighters that fly at high altitude and are almost always on the ground, and there are large bombers that fly at altitudes that are not very much different from the subsonic aircraft. The total amount of flight at very high altitudes by military aircraft is very small.

There are large numbers of military aircraft but even larger numbers of subsonic aircraft that are flying all the time. The atmospheric modeling that is going on is concerned with what happens to the emissions from subsonic aircraft as well. In general, the subsonic aircraft fly very much closer to the tropopause and sometimes in the troposphere itself. The higher you fly in the atmosphere, the longer the pollutant is going to stay there. If you get up into the stratosphere at 20-25 kilometers, then you are talking about one or two years for these materials to come back down, whereas if you fly not very much above the tropopause, then it may be a matter of weeks for removal of the pollutants. The tracer experiment discussed earlier is designed to find out what the residence time of the pollutants would be by doing an experiment in which you actually put something into the atmosphere and watch how long it stays.

I think the fundamental answer is that the hope of this Scientific Advisory Committee would be to forestall problems rather than to discover them retroactively.

MR. DENSMORE: I am sure you appreciate the larger problem here, clearly 500 supersonic airplanes in commercial service is a lot of airplanes compared to what is flying today but the economists are very, very pessimistic and they don't think there are going to be very many supersonic airplanes flying in commercial service for some time. Five hundred times a small number can be an appreciable number but 10 or even 15 times a small number still is probably pretty small. Have you considered in your discussions what is a minimum effective program?

To me, you are talking about not just what the FAA is doing, but what a lot of other organizations are doing. There is a lot going on here of which the FAA's is only a portion. But you get down below some level, I think we all intuitively know the thing decays. I wonder if you have talked about this any?

CHAIRMAN ROWLAND: We have certainly worried about the specific role of the FAA and the question of who would study the aircraft problems if they did not, or whether it would ever get done. We have been trying to identify those problems which are specifically related to the FAA and to see in what way, through the operation of HAPP you can make the experiments come out to answer the aircraft emissions problem.

The primary problem at the present time insofar as stratospheric ozone depletion is concerned is connected with chlorine. NASA is concerned with this because they produce chlorine from the Space Shuttle. So they are going to be very much interested in what happens to the chlorine species.

The Space Shuttle is going to leave a column of effluents in its wake which will extend up to 43 kilometers so they have an interest in a variety of altitudes, including some much higher than those which would be pertinent for supersonic aircraft. If NASA is left to investigate by itself, then you are going to get a bias toward making sure that you cover all the bases for the rocket.

There is also concern about the emissions from anthropogenic uses of various chlorine compounds. These molecules decompose in the atmosphere at about 30 kilometers which is also above the aircraft altitude. Those experiments are going to be done by NASA as NASA has to keep an eye on these particular problems. What FAA needs to do is to make sure at the same time that the question of what happens to materials injected at 17 kilometers on the way between London and New York gets solved. That is a different problem. It involves the same atmosphere but it has some specific characteristics which are different and which, if FAA weren't involved, might not get solved by NASA.

DR. CRUTZEN: May I bring in a point here? It is true that I don't see--any of us would see--500 supersonics flying around in the future, but the subsonics are going much higher, in increased numbers, in the future. The difference is getting close to two kilometers there; we should be concerned about this.

CHAIRMAN ROWLAND: It is clear in this respect that when they put in the 747 SP's and started flying the polar route, they found that they were getting ozone in the cabin. As you start moving up two or three kilometers into the stratosphere, your pollutants are going to have longer lifetimes and as Paul (Crutzen) says, it isn't the question of supersonic transport; it is the altitude at which you fly the airplanes.

MR. DENSMORE: I think it is certainly true that the operation of the Concorde has made people more comfortable with the subsonic airplanes also flying at higher altitudes. There is continual pressure to certificate operation at higher altitudes.

CHAIRMAN ROWLAND: There has been a large amount of concern about the possibility of the effects of nitrogen oxides on the ozone and I think it would be a mistake for FAA to walk away from the problem until they had a satisfactory solution. I don't think that you can get a satisfactory solution until you have taken into account the results of validated three-dimensional models.

MR. DENSMORE: Okay, that logically leads to the other question I wanted to ask. When you talk about modeling the atmosphere and making measurements to see that your models have some validity to them, most of the old World War II pilots in the FAA immediately think of meteorology and weather forecasting. We still don't do a very good job of this. Why do you think that the HAPP program will do a better job on what to most people at the FAA, seems like the same problem? Is that a loaded question? I intended it to be.

CHAIRMAN ROWLAND: If you think at the end of the HAPP program we will be able to tell you when it is going to rain in Washington, "no." HAPP is not intended to do that. However, there are several aspects to consider. One is that the upper part of the stratosphere is very much more stable and is under chemical control. In it, the time scales for motions are relatively long; the time scale for the chemistry is relatively short. Under such conditions, most molecules are affected by the sun very rapidly. If you measure the amount of ozone and you measure the number of oxygen atoms, the control over how much ozone and how many oxygen atoms there are depends strongly on the radiation flux from the sun and not very much on where that air has been before. The chemical situation adjusts very quickly if the sunlight conditions are changed.

However, if you come down to 17 kilometers where the aircraft fly, you are in a location where the chemical response to the sun is very much slower. Then the question of the past history of this mass of air is very much more important and it is under meteorological control. If you are going to have any kind of model of the chemistry, and the removal of ozone is a chemical process, then you certainly need to have a model which works in those altitudes which are under chemical control. These tests of the validation of the models are largely chemical tests and they are going to be applied initially at altitudes of 30 to 40 kilometers where one expects the meteorology to be slow compared to the chemistry. If you test the chemistry there, you can find out whether the chemistry is right. Then as our understanding of the atmosphere evolves gradually, we will be able, hopefully, to apply this chemistry to the lower altitude regions in which meteorology becomes important and even becomes dominant.

The understanding and the modeling of the atmosphere is in a much better situation than 5 years or 10 years ago, but will be even better in 1990 than in 1980.

And, in 1990, we probably still will not know whether it is going to rain in Washington. Dieter (Ehhalt).

PROFESSOR EHHALT: If I could try for a moment to summarize what Jerry (Mahlman) has stated, in a way which is more germane to the way you posed your question. The reason really is that when we look at the chemical forecast, we look at averages, at the climatological averages, if you want. Suppose we want a weather forecast - and the climatological average is a little easier to predict - in fact, if you will take the average summer temperature; next year it will be about the same as this year. You are not so far off the mark as if you predict rain for 14 days. I think that is sort of the basic answer you were trying to give them.

DR. MAHLMAN: I think that is a pretty straight answer. I was thinking of an analogy, because weather is very difficult to forecast. You can make some arguments as to why that is fundamentally so. To me, the difference between a specific detailed forecast such as a weather forecast and a climate forecast, or an average forecast, as Dr. Ehhalt points out, is rather difficult. Anyone who has grown up in the United States is aware of the pinball machine. In the pinball machine, the path of a particular ball is extraordinarily difficult to predict. But the statistics of thousands of balls that go through are very stable. In a sense, if I had a pinball in which I took out a couple of the bumpers, that would still make the detailed forecast of the particular ball as difficult as before. But it is not unreasonable to expect that the statistics of the balls would be predictable in a new sense, so that is the difference in a weather forecast and this business here.

MR. DENSMORE: Yes, that is a good analogy because the economy in Nevada depends on that being true.

(Laughter)

DR. MAHLMAN: That is another good one.

MR. DENSMORE: Well, this discussion has been very helpful to me. I find that people - if you have an Advisory Committee - really won't attack the technical judgment. They haven't got any way to attack what to me are bureaucratic issues, and I guess my prime responsibility here is to be prepared to handle bureaucratic issues and you are helpful to me.

CHAIRMAN ROWLAND: Barry (Pittock).

DR. PITTOCK: Let me address something to the first question, whether there have been particular changes?

MR. DENSMORE: Yes, let me elaborate on that a little bit. I guess the feeling of a number of people is that the natural variations in ozone are very large compared to the kinds of things that we are considering here might be of concern.

CHAIRMAN ROWLAND: I will respond to that. The temperature variation in Washington over a year is very large. It can be 100 degrees here and it can be well below freezing. However, if you were to change the average temperature of Washington downward by 3 degrees, it would make an appreciable difference in the living conditions. At the same time, you would have difficulty showing in only a few years that a climatic effect of 3 degrees had actually happened. You would just say, "Damn, it was cold last year. I wonder if the climate has changed?" And it would take a long time statistically to prove that the climate had shifted by 3 degrees. You have a 100 degree variation that occurs every year anyway, but 3 degrees would be important on the average.

MR. DENSMORE: Yes, and again it is climatology versus --

CHAIRMAN ROWLAND: One can describe the ozone similarly. The fact that ozone varies from day to day by a large amount doesn't mean that a smaller change in the average amount of ozone would not be important.

MR. DENSMORE: Well, if the Department of Energy really goes ahead and says you can't turn the air conditioner on until it gets up to 80 inside, we are going to get a real clear indication of just what you are saying.

CHAIRMAN ROWLAND: Barry (Pittock).

DR. PITTOCK: Well, what I was trying to say was because of eventual variability, there is a fundamental limit on the predictability of the change. You need quite a number of years in order to detect a change, say ten years to detect a change of 1 percent to 2 percent. This means that there is a certain lead time required. You are in effect causing a change, but you won't know you have changed anything until some years later. If changing the average by a given amount is important in a practical sense, it is because it might lead to skin cancer or whatever, then you would like to know the lead time required for monitoring the change. That is why one has to address change through models and predictions. You have to rely to some extent on prediction because if you are going to rely only on monitoring, you only know you have changed it well after you have changed it.

CHAIRMAN ROWLAND: Scientists environmentally are becoming more ambitious. They are trying to avoid problems instead of discovering the ones that have already happened.

MR. DENSMORE: Okay. That raises another question but I am going to have to do some homework on this. How in a two- or three-year measurements program are you hoping to find these things out when really it will be a long time before you can really detect them?

CHAIRMAN ROWLAND: You don't expect to complete the measurements. We expect the study of the atmosphere to be going very well in the year 2000. There will be valid important experiments going on then, but they will involve a very much more complex model of the atmosphere than now exists. There will be much more detailed tests of the models at that point.

What we would like to have at the present time is simultaneous measurements of the nitrogen oxides which are intimately involved in the ozone balance to make sure that nothing important is now being left out. If your model works at 35 or 40 kilometers, if you know how much nitrogen is present, you should be able to tell, because it is under chemical control, how much of it is in the form of each of the nitrogen oxides and how much is nitric acid.

If that model works and the tests validate it, then the next step is to say, "Well, then, let's see what else we can predict," and you start asking for finer and finer detail. But we are still in a relatively primitive stage and the hope is that in several years we will be able to have a model which handles nitrogen oxides very well and which, therefore, has some validity in forward prediction of the effects of the nitrogen oxides put in by aircraft.

DR. SCHMELTEKOPF: I wanted to make one comment concerning your first question about the HAPP budget, and what kind of influence it has, and whether or not it is enough or not enough. I think that all of us would agree that HAPP is obtaining an incredible leverage effect with its dollars.

There is more money being spent by NASA and places like that, but HAPP's influence has been quite large and they have been able to leverage their money into some fairly significant programs without too much cost. I think in that sense, the money has been spent very effectively and it is having quite a lot of influence on this field.

MR. DENSMORE: Yes, I think that is a very important argument. I guess what I was alluding to earlier was since nobody really believes there is going to be large numbers of SST's flying soon, why can't the program be stretched out over a much longer period of time.

CHAIRMAN ROWLAND: As long as you guarantee that the subsonic aircraft aren't going to increase in number or go at higher altitudes in the next 15 years, then we could stretch it out. But, if you think they are going to continue to go up, then you may want the answer before the SST's come in.

MR. DENSMORE: Yes, I hadn't thought of the horrors of deregulation on this.

(Laughter)

DR. MAHLMAN: I think it would be far easier to establish a logical argument in favor of a stretched out program than a short time scale program with quick termination because of the nature of the problem.

CHAIRMAN ROWLAND: What you are saying is that -- if I interpret it, presently HAPP is scheduled to go for another four years or so.

DR. MAHLMAN: Yes.

CHAIRMAN ROWLAND: The likelihood that there will be aircraft emission problems still being considered in the late 1980's is very high. FAA does need to worry about what they are going to do when they don't have a HAPP program. After it ends, there could be a point at which FAA is no longer well informed about the problems, and an environmental problem could suddenly spring up. Ralph (Cicerone).

DR. CICERONE: I suspect there is an element of service to industry in the FAA's mandate. By getting answers to some of these questions, at least more precise answers, the FAA might succeed in giving the aviation industry more time to reengineer, redesign aircraft, if it is necessary. And the sooner we give them lead time the better.

CHAIRMAN ROWLAND: And you certainly don't want to reengineer or redesign. You want to have it included in the initial engineering.

DR. CICERONE: Yes.

DR. SCHMELTEKOPF: The important point in Jerry's (Mahlman) statement is the fact that one of our really key experiments is this injection (tracer experiment). And I don't really believe anybody could say they believe that you could do that experiment by the proposed deadline. It will take longer than that to get approval by all the international governments that will be concerned with trying to make these measurements and getting it into the MAP* program. That is an international program that would probably be involved and it doesn't fire up till '82. So in that sense, for these dynamical measurements, we hope to have some of the chemistry, at least the odd nitrogen chemistry partially under control by that time. These dynamical questions are going to go on and they are going to go on for a long time.

CHAIRMAN ROWLAND: Thank you. Are there any other comments that any of the other members of the Committee want to make to Mr. Densmore? If not, I would suggest that the only thing that we have left to do is to discuss when we are going to meet again.

MR. DENSMORE: Is it going to be in the next fiscal year?

CHAIRMAN ROWLAND: We have been discussing the frequency with which this Committee would meet, and have decided that is should be every eight or nine months. Discussions with Ram (Sundararaman) suggest that perhaps late next January might be a reasonable time for the next Committee meeting.

MR. DENSMORE: From a budgetary cycle, yes.

CHAIRMAN ROWLAND: That is after October 1.

MR. DENSMORE: That is right. Just to give a little flavor of the kind of problem I am trying to make sure is also handled - last year Congress, quite surprisingly to me, severely reduced our noise abatement money with the comment that the FAA has solved the problem. George (Kittredge), I am sure your peers over there at EPA will not agree with that any more than we do. But somehow or other, we just didn't make the right impression on them and I want to try to keep a similar thing from happening here, certainly unexpeotedly.

CHAIRMAN ROWLAND: Ram (Sundararaman) and I have talked about it, and we were thinking of January. I have a specific set of dates picked out: Wednesday through Friday, January 23rd to 25th. There is nothing as far as I know magical about that particular week or Wednesday through Friday. The only thing about it is that on my schedule, it is not yet booked and probably on most of your schedules it is not yet booked. If we put it down, then at least we have solved some of the possible conflict problems that would arise later.

*Middle Atmosphere Program

If we take January 23rd to 25th, does anyone have any reason why that is not a good time? One tentative plan then will be a time schedule roughly what we have now, the 10:00 o'clock start on Wednesday, breaking up by noon on Friday. Now, we are not quite in the same situation as the American Chemical Society which can tell you ten years from now where the meeting is going to be. Nine months ahead is probably reasonable for picking out a date and fixing it.

DR. SUNDARARAMAN: Any agenda items that Committee members would like to see on the next meeting? Or should we form an agenda and circulate that?

CHAIRMAN ROWLAND: We are certainly going to go over all of the programs that at that time are being funded. This meeting has been very specifically oriented toward the field measurements. Next time, we will want to go back to the entire program and look at it again to see whether there are holes in it that we think ought to be patched up.

DR. PITTOCK: I don't know whether it is the staff function or Committee function but I wonder whether we should be at least keeping ourselves abreast of what some of the other agencies are doing. I am thinking of the role NASA is taking in regards to credible monitoring, with some reports on perhaps the state of the art and on what the present results indicate in terms of whether ozone is going up or down or whatever. These would be useful and germane to the kinds of questions the Assistant Administrator was asking.

CHAIRMAN ROWLAND: I think what they will need to know is something about the level of sensitivity detection, but that is something that the staff can pass onto him.

DR. SUNDARARAMAN: Yes. FAA is a member of a large number of committees. Shelby (Tilford) is a member of this Committee and he will surely keep us informed of what is going on. I don't see any difficulty in finding out what the other agencies are doing.

CHAIRMAN ROWLAND: Are there any comments that anyone feels we need to have before we adjourn? No? With that, then, we will adjourn the meeting.

(Whereupon, at 11:40 a.m., the hearing was concluded.)

PART II

RECOMMENDATIONS FOR FIELD MEASUREMENTS

RECOMMENDATIONS FOR FIELD MEASUREMENTS
(Noted by the Rapporteur, Dr. Ralph Cicerone)

1. In-Situ Measurements of Stratospheric Gases

A. Goals: To reduce the quantitative uncertainties in theoretical predictions of the atmospheric and climatic effects of aviation so that better foundations will be available to FAA and the aviation industry for regulatory and engineering decisions. In particular, it is necessary to achieve more quantitative and confident assessment of the effects of aircraft emissions, principally nitrogen oxides and water vapor, on stratospheric chemistry, radiation and atmospheric circulation.

B. Description of Program of Measurements of Stratospheric Gases: It will be a small-scale but significant set of measurements of stratospheric concentrations of selected, naturally-occurring nitrogen compounds and related key variables.

Phase I - Minimum Measurement Set - (to measure key photochemical ratios and concentrations, to deduce the budget of natural stratospheric nitrogen oxides and to allow convincing demonstrations of measurement hardware.)

To be Measured:

Nitrogen Oxide - NO
Nitrogen Dioxide - NO_2
Total Odd Nitrogen
Ozone - O_3
Photodissociation rate of nitrogen dioxide - $J(NO_2)$
Temperature

Location	Frequency
First Launch Site - Mid Latitude (e.g., Texas)	2 to 6 Flights
Second Launch Site - (Southern Hemisphere, or low or high latitude)	1 or 2 Flights

Phase II - With proven instruments, to extend the measured species set so as to allow better validation of the photochemical scheme of the stratosphere.

To be Measured:

Nitrogen Oxide - NO
Nitrogen Dioxide - NO_2
Nitric Acid - HNO_3
Total Odd Nitrogen
Ozone - O_3
Atomic Oxygen - O
Photodissociation rate of nitrogen dioxide - $J(NO_2)$
Temperature
Carbon Monoxide - CO
Perhydroxyl Radical - HO_2
Hydroxyl Radical - HO

Location	Frequency
Mid latitudes	3
Low latitudes	2-3
High latitudes (To include Southern Hemisphere if feasible.)	2-3

C. Measurement Platforms, Logistics: This field measurement program will require launches of large scientific balloons bearing payloads in the 15 to 50 km altitude region. To avoid excessive costs and logistical problems of launching from ill-equipped stations some global coverage must be sacrificed. Projected costs and budget constraints imply that extant balloon-launching facilities must be used as fully as possible. For example, Phase I will almost certainly be centered at the National Scientific Balloon Facility in Texas, and possibly involve Canadian and Panamanian sites. Phase II could include the Southern Hemisphere, if at all possible. Instruments or portions of payloads are hoped to be re-usable after recovery but development and testing costs are high.

The HAPP staff must continue to be resourceful in seeking interagency and international arrangements to defray costs and to supplement the activities of HAPP. Possibilities of gains to HAPP through the proposed international Middle Atmosphere Program should be explored.

2. Feasibility Studies for Tracer Measurements

A. Goals: To obtain empirical data on stratospheric and upper tropospheric air motions and thus to allow refinements of predictive circulation models.

B. Elements of Tracer Experiments to be Considered: By measuring concentrations of chemical tracers, it is intended to gain empirical knowledge of how aircraft emissions in the lower stratosphere disperse to the high stratosphere and downward into the troposphere. The tracer substances to be used would be measured by grabbing air samples from aircraft or small balloons and subsequently analyzing them in the laboratory.

Tracers would be naturally occurring chemicals or benign synthetic substances or both. Careful selection requires consideration of costs, safety, optimization to the task, analytical procedures and possible interferences with any future investigations. Injections of synthetic tracer substances directly into aircraft corridors are especially attractive simulators of HAPP-specific scenarios.

Sampling frequency, locations and platforms must be carefully considered.

APPENDIX I

AGENDA

HIGH ALTITUDE POLLUTION PROGRAM

SCIENTIFIC ADVISORY COMMITTEE

SECOND MEETING

MARCH 28 - 30, 1979

SECOND MEETING

HIGH ALTITUDE POLLUTION PROGRAM

SCIENTIFIC ADVISORY COMMITTEE

AGENDA

March 28, 1979: Wednesday

10:00 - 10:30 A.M.	Opening Remarks and Adoption of the Agenda
10:30 - 11:30	Hybrid Measurement System: N. Macoy, Perkin-Elmer Corp.
11:30 A.M. - 1:00 P.M.	Lunch
1:00 - 2:00	Multispecies Measurement System: D. Hinkley/J. Peterson, NASA Jet Propulsion Laboratory
2:00 - 3:00	Tunable Diode Laser Spectrometer: H. Schiff, York University
3:00 - 3:15	Break
3:15 - 4:15	Laser Diode Laboratory Effort: S. Poultney, Perkin-Elmer Corp.
4:15 - 5:00	Discussion
5:00	Adjourn

March 29, 1979: Thursday

9:00 - 9:45 A.M.	Rainout Study: S. Schwartz, Brookhaven National Laboratory
9:45 - 10:30	Atmospheric Tracer Experiment: P. Guthals/M. Fowler, Los Alamos Scientific Laboratory
10:30 - 10:45	Break
10:45 - 12:00 Noon	Discussion
12:00 Noon - 1:30 P.M.	Lunch
1:30 - 3:30	Discussion
3:30 - 3:45	Break
3:45 - 5:30	Discussion

March 30, 1979: Friday

9:00 - 10:00 A.M.	Discussion
10:00 - 10:30	Break
10:30 - 11:00	Rapporteur's Report
11:00 - 12:00 Noon	Discussion; Dates and Agenda for the Next Meeting
12:00 Noon	Adjourn

APPENDIX II

ATTENDEES

HIGH ALTITUDE POLLUTION PROGRAM

SCIENTIFIC ADVISORY COMMITTEE

SECOND MEETING

MARCH 28 - 30, 1979

ATTENDEES

SECOND MEETING OF

HIGH ALTITUDE POLLUTION PROGRAM

SCIENTIFIC ADVISORY COMMITTEE

MARCH 28-30, 1979

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APPENDIX III

CHARTER

AND

MEMBERS OF

HIGH ALTITUDE POLLUTION PROGRAM

SCIENTIFIC ADVISORY COMMITTEE

SECOND MEETING

MARCH 28 - 30, 1979

ORDER

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

1110.83A

4/14/78

SUBJ: HIGH ALTITUDE POLLUTION PROGRAM SCIENTIFIC ADVISORY COMMITTEE

1. PURPOSE. This order amends the charter of the High Altitude Pollution Program Technical Advisory Committee and changes its name to the HIGH ALTITUDE POLLUTION PROGRAM SCIENTIFIC ADVISORY COMMITTEE.

2. DISTRIBUTION. This order is distributed to division level in Washington and centers and director level in the regions.

3. CANCELLATION. Order 1110.83, High Altitude Pollution Program Technical Advisory Committee, is canceled.

4. BACKGROUND. The Office of Environmental Quality, Federal Aviation Administration (FAA), has established the High Altitude Pollution Program (HAPP) charged with a continuing effort to determine quantitatively the requirements for reduced cruise-altitude exhaust emissions by high altitude aircraft and to determine what regulatory action, if any, is needed to avoid environmental degradation. Accordingly, HAPP must pursue programs related to aircraft engine emissions improvement, aircraft operations, stratospheric measurements, computer modeling of stratospheric processes, laboratory measurements related to stratospheric phenomena, and monitoring of stratospheric phenomena. HAPP has the lead role for the Department of Transportation in carrying out U.S. responsibilities defined in the May 1976 Tripartite Agreement Regarding Monitoring of the Stratosphere, which was signed as a result of one of the actions directed by the Secretary in his February 4, 1976, decision on Concorde. The program must draw upon FAA-sponsored research and on the work of other U.S. and international organizations. It has implications for the aviation manufacturers, airlines, and the general public, both in the United States and internationally. For these reasons, it has been determined necessary to have a HAPP Scientific Advisory Committee to serve the manager of HAPP in assessing and advising on elements of HAPP.

5. OBJECTIVE AND SCOPE OF ACTIVITIES. The objective of the Committee is to review the scope, adequacy, and priorities of HAPP, advise on areas of research that may contribute to the analyses conducted by HAPP, appraise analyses conducted, advise of relevant results in related fields of investigation, and assist in coordinating the relevant programs of other Government agencies with those of HAPP.

6. DESCRIPTION OF DUTIES. The Committee's activity is limited to program review and submission of recommendations and advice to the HAPP program manager.

7. ORGANIZATION AND ADMINISTRATION.

* a. The HAPP Scientific Advisory Committee shall have up to twenty-five * members consisting of representatives of the aviation industry and scientists and engineers from Government, specifically including, but not limited to, representatives of the Department of Defense, the Environmental Protection Agency, the National Aeronautics and Space Administration, and the National Oceanic and Atmospheric Administration, industry, and universities. Persons chosen for membership on the Committee are selected on the basis of their recognized expertise and ability to contribute significant advice to the FAA in technical areas, such as aircraft engine emissions measurement or improvement; aircraft operations; stratospheric measurements; computer modeling of stratospheric processes; laboratory measurements related to stratospheric phenomena; and monitoring of stratospheric phenomena. Committee participation by non-Government members does not make them special Government employees. The non-Government members shall be selected by the Associate Administrator for Policy Development and Review, with the approval of the Administrator and the Secretary of Transportation, and such members shall be selected so as to be fairly balanced in terms of points of view represented and functions to be performed by the Committee.

* b. The Administrator is the sponsor of the Committee and shall appoint the chairman. The Director of Environmental Quality is responsible for pro- * viding the administrative support for the Committee and shall provide a secretariat. The executive director shall be the FAA's Associate Administrator for Policy Development and Review. The Committee shall not conduct any meeting in the absence of the executive director or the designated alternate. The executive director or the designated alternate, who as the designated Federal employee, shall be authorized to adjourn any advisory committee meeting whenever he determines adjournment to be in the public interest.

* c. The chairman shall be responsible for: *

(1) Determining, with approval of the executive director, when a meeting is required.

(2) Formulating an agenda for each meeting, which will be approved in advance by the executive director.

(3) Providing for notice to all members of the time, place, and agenda for any meeting.

(4) Conducting the meeting.

(5) Providing for the taking of minutes at each meeting and certifying the accuracy of the minutes.

d. The number of meetings is expected to be one, and possibly two, per year.

e. Detailed minutes shall be kept of each Committee meeting. The minutes shall include the time and place of the meeting; a list of Committee members and staff and agency employees present at the meeting; a complete summary of matters discussed and conclusions reached; copies of all reports received, issued, or approved by the Committee; a description of the extent to which the meeting was open to the public; a description of public participation, including a list of members of the public who presented oral or written statements; and an estimate of the number of members of the public who attended the meeting.

f. The Committee meetings shall be open to the public, and timely notice of such meetings shall be published in the Federal Register at least 15 days before the meeting. The proposed agenda, as well as the time and place of the meeting and information that the meeting will be open to the public, shall be included in the notice which shall be forwarded to the Chief Counsel, Attention: Rules Dockets Section, AGC-24, approximately 30 days before the meeting. Other forms of notice, such as press releases, are to be used to the extent practicable.

g. Members of the Committee who are full-time employees of the United States shall serve without compensation but may be allowed transportation and per diem in lieu of subsistence and other expenses, in accordance with the Department of Transportation's Civilian Travel Regulations.

8. ESTIMATED COST. The estimated annual operating cost of the Committee is $10,000, which includes the travel costs and compensation of the members and miscellaneous costs, such as the printing and issuance of reports. Approximately 0.2 employee-years will be required to support the Committee, including both professional and secretary services.

9. COMPENSATION. Members of the Committee who are not full-time employees of the United States, while attending meetings of the Committee or otherwise engaged in the business of the Committee, shall be entitled to compensation of $100 per day and transportation and per diem in lieu of subsistence and other expenses in accordance with the Department of Transportation's Civilian Travel Regulations.

10. PUBLIC PARTICIPATION. Each Committee meeting shall be open to the public and interested persons shall be permitted to attend, appear before, or file written statements with the Committee, subject to the limitations contained in the exception to the Freedom of Information Act (Title 5, U.S. Code 552(b)) and also subject to limitations of space and time.

11. AVAILABILITY OF RECORDS. Subject to the limitations contained in the exceptions of the Freedom of Information Act (Title 5, U.S. Code 552(b)), records, reports, transcripts, minutes, and other documents that are made available to, or prepared for or by, the Committee shall be available for public inspection and copying at the Office of Public Affairs 800 Independence Avenue, S.W., Washington, D.C. 20591. Fees shall be charged for information furnished to the public in accordance with the fee schedule published in Part 7 of Title 49, Code of Federal Regulations.

12. PUBLIC INTEREST. The formation and use of the HAPP Scientific Advisory Committee is determined to be in the public interest in connection with the performance of duties imposed on FAA by law.

13. EFFECTIVE DATE AND DURATION. This charter was filed on June 12, 1978, which is its effective date. The Committee will remain in existence for two years subsequent to this date, unless sooner terminated or extended. (Since HAPP will be in effect for eight years, the Committee will be needed for eight years. Accordingly, the charter will be refiled after the two-year period.)

Langhorne Bond

Langhorne Bond
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HIGH ALTITUDE POLLUTION PROGRAM
SCIENTIFIC ADVISORY COMMITTEE

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*ADDRESSES UPDATED JANUARY 1981

* U. S. GOVERNMENT PRINTING OFFICE: 1981—341-428/1143

DATE

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